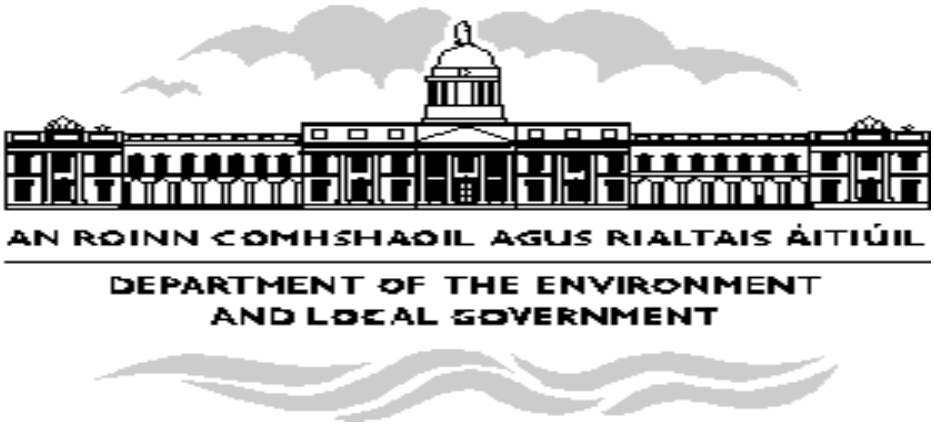
REQUIREMENTS FOR VOTING MACHINES FOR USE AT ELECTIONS IN IRELAND



DVREC-2 (5 March 03)

REQUIREMENTS FOR VOTING MACHINES FOR USE AT ELECTIONS

Legal requirements

The Electoral (Amendment) Act, 2001, Part 3 (Direct vote recording and electronic vote counting) provides that voting and vote counting at certain statutory elections may be undertaken on voting system equipment approved for such purposes by the Minister for the Environment and Local Government. Before such approval is granted, the following requirements (including the Appendix to this document) must be complied with by the voting machine manufacturer.

Requirements

1. A prototype of the voting machine, including any ancillary equipment, must be inspected by one or more organisations which hold relevant accreditation by a national accreditation body of an EU Member State. The term voting machine is deemed to include the ballot module and programming unit.

2. The prototype voting machine, including any ancillary equipment, must comply with the Functional Specification, this document and statutory requirements. The manufacturer must furnish a statement to the Minister from an organisation referred to in paragraph 1 that the prototype machine, including any ancillary equipment, complies with the documents referred to in this paragraph.

3. Following approval of the prototype voting machine, the manufacturer of a voting machine shall submit a statement to the Minister from an organisation referred to in paragraph 1 that a voting machine, chosen from a number of at least ten machines that have been placed at the disposal of the organisation by the manufacturer, is sufficiently in accordance with the prototype which has been approved.

4.1 When a voting machine has been approved for use in elections, the Minister may require a periodic inspection of the voting machines being produced. Where such an inspection is required, the manufacturer shall submit a voting machine, chosen by an organisation referred to in paragraph 1, from a

number of at least ten machines placed at the disposal of the organisation by the manufacturer, for the purpose of an inspection by the organisation.

4.2 During the periodic inspection, an organisation referred to at 1, shall investigate whether the voting machine is sufficiently like the prototype and complies with the requirements set out in this document.

4.3 The manufacturer will report the results of the periodic inspection to the Minister.

5. The Minister may withdraw an approval of a prototype of a voting machine or of a voting machine for use in elections in Ireland, when:

(a) the use of the machine leads to objections, which, in the Minister's opinion, could endanger the proper conduct of elections; or

(b) the voting machines used at the elections do not sufficiently match the prototype or do not meet the conditions under which the prototype had been approved; or

(c) the manufacturer does not comply with paragraph 4.

Where the Minister withdraws an approval of a prototype or of a voting machine, the Minister will inform the manufacturer. The manufacturer may submit a prototype of the voting machine or a voting machine, selected by an organisation referred to at paragraph 1 from a number of at least ten machines made available to it, for a re-inspection by the organisation. The manufacturer shall furnish to the Minister a report from such an organisation in accordance with paragraphs 2 and/or 3.

6. For small adjustments to an approved voting machine for use in elections that do not materially affect the prototype, the manufacturer shall inform the Minister, who may require an inspection of the voting machine in accordance with paragraph 4.

APPENDIX

PART 1

Conditions for voting machines

1. **General**

1.1 The requirements for voting machines contained in the Functional Specification document (version 1.7 of 5 March 2003), the electoral law and this Appendix are mandatory.

1.2 The voting machine shall be constructed in line with the current general state of technology and be designed in accordance with recognised rules of technology applied to systems used in the machine.

1.3 The voting machine shall be designed in such a way that any unauthorised alterations of a technical nature will come to notice.

1.4 In the case of a processor–controlled machine, any alteration of the installed software by an unauthorised person will be detected.

1.5 The relevant statutory procedures for the preparation of a voting machine for a poll, use at a poll and at the close of a poll shall be capable of being performed by the voting machine. The word “poll” is deemed to include more than 1 poll (maximum 5) held simultaneously.

2. **General conditions concerning the provision of information by the voting machine**

2.1 The information provided by the voting machine to the user (polling staff and voter) must be relevant and clear.

2.2 The voting machine must provide the user (polling staff and voter) with information, either on the display screen on the voting machine or on the Control Unit or otherwise, on the steps that the user must or can take in

sequence using the voting machine and about the functions the voting machine is carrying out pursuant to the actions taken by the user, subject to the condition that the candidate or referendum choices recorded or vote(s) cast on the machine by the voter cannot be related to that voter either at the time of voting or subsequently.

2.3 The voting machine must provide a statement before polling commences and at close of poll listing the candidates on the ballot paper, the total number of activations of the voting machine, the number of votes cast, if any, including any null* votes in the case of multiple polls, on the machine, number of deactivations of the voting machine where a voter does not press the "CAST VOTE(S)" button and other relevant details of the voting machine and the poll(s) concerned.

3. **Installation of a ballot module**

3.1 Following the insertion of a programmed ballot module into the voting machine, the voting machine shall carry out the following functions in sequence:

- check to ensure that the voting machine is functioning correctly as defined in the Functional Specification; and
- display and/or print the contents of the memory of the primary ballot module.

3.2 The insertion of a primary ballot module shall be controlled by means of a physical key. The compartment for holding the primary ballot module shall be provided with a lock and with a covering flap with holes for insertion of a seal. The machine can only be activated for voting if a module has been installed and the lock on the ballot module slot is in the closed position.

* A **Null vote** is recorded by the voting machine where, in a multiple ballot paper situation, after a message is displayed on the machine, a voter casts his/her vote(s) without recording a preference on each activated ballot paper. In such a situation, a null vote is stored in respect of each poll for which no preference was recorded. This enables the voting machine to maintain an electronic record of voting or non-voting at each poll on the machine and assists the reconciliation of the number of voters permitted to use the voting machine and the final statement produced by the voting machine of the votes cast at each poll on the machine.

3.3 A back-up module shall be installed and retained in the voting machine in accordance with the Functional Specification.

4. **Displaying ballot paper**

The ballot paper displayed on the voting machine must comply with the Electoral Act, 1992, the Electoral (Amendment) Act, 2001 or relevant Ministerial Order under section 48 of the Act of 2001 and must be verified by statements printed from the voting machine before voting commences and at close of poll.

5. **Preparation before the poll**

5.1 A voting machine can only be used for a poll, after it has carried out or supported the following steps in sequence:

- demonstrated, by way of a printed statement or on the display screen, that no votes are recorded; and
- checked that the voting machine is functioning correctly in accordance with the Functional Specification (Chapters 2 and 8).

5.2 Votes shall only be recorded if the key referred to in 3.2. is inserted in the Control Unit. Withdrawal of the key from the Control Unit will switch the voting machine to standby and prevent votes from being recorded.

6. **The poll**

6.1 The voting machine shall not record votes unless it has been activated.

6.2 For the recording of votes, the voting machine shall carry out or support the following steps in sequence:

- the voting machine is activated for each voter by the presiding officer or a person authorised by the officer- each activation will be recorded by the voting machine;

- LED at top of each ballot paper column highlights ballot paper(s) on which a voter is entitled to vote;

- LED displays to the right of the ballot paper shall display the marks "----" on open ballot papers(s);

- LED-displays opposite each candidate's details or referendum choice will display the preferences recorded on each ballot paper presented on voting machine; in the case of a referendum, the "x" shall be in the left hand position of the LED;

- when a preference is recorded , details will be displayed on the bottom line of the voting machine display screen;

- provision for changing a preference for a candidate or referendum choice will be provided by pressing the button a second time beside that candidate's details or referendum choice;

- a voter will be able to cast his or her vote when at least one preference has been recorded on a ballot paper and, where there is more than 1 ballot paper and no preference(s) is/are recorded on the second or other remaining ballot papers, following a reminder displayed on the display screen;

- a vote will be recorded, including a null vote* where applicable, in the voting memory of the voting machine, following the pressing of the "CAST VOTE(S)" button. This process shall include a check that the recording of the vote(s) cast has/have been accomplished correctly. If a vote is not recorded, an error message shall be displayed;

- if the voting machine is de-activated by the polling staff when a voter fails to press the "CAST VOTE(S)" button, each such de-activation shall be recorded in the memory of the voting machine;

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* See footnote on page 5

- no action by the voter or polling station staff can interrupt the recording of a vote after the “CAST VOTE(S)” button is pressed e.g. turning key on Control Unit.

6.3 After each vote is stored, the voter’s panel on the voting machine shall be de-activated automatically. The voting machine will not accept any further votes until a member of the polling station staff, operating the Control Unit, reactivates it.

6.4 Where the voter, who has been permitted to use the voting machine, does not cast his or her vote, the polling staff can de-activate the voting machine, without approaching the voting machine screen, by turning the key mentioned in 5.2. Any preference(s) entered on the voting machine screen will not be recorded as a vote. A deactivation of the voting machine, following the non-use of the “CAST VOTE(S)” button, shall be recorded in the memory of the voting machine. A new activation is only possible after use of the key mentioned in 5.2.

6.5 Once the voter has pressed the “CAST VOTE(S)” button, the voting machine shall not provide information about any preference(s) recorded or vote cast by a voter,.

6.6 The number of votes cast, including null votes in the case of multiple polls, will be displayed on the Control Unit and on the voting machine in stand-by mode.

7. Displaying and printing the total number of votes at close of poll

7.1 The voting machine shall display, where necessary, the total number of votes cast and, where applicable, the number of null votes; additionally it shall print, where necessary, the total number of voters who were permitted to use the machine (activations); the total number of votes cast, the number of null votes and the total number of de-activations.

7.2 Activation of the voting machine for the display and printing of the information referred to in paragraph 7.1 shall be accomplished by means of the key referred to in paragraph 5.2. The back-up module shall be checked to ensure that any existing data in the module is deleted, before the contents of the primary ballot module are copied to the back up module. Withdrawal of the key from the Control Unit will automatically stop the printing process.

7.3 After displaying or printing the total number of votes cast etc, the voting machine can only be re-activated for the casting of votes after the insertion of a new programmed ballot module.

8. **Reliability and security of the voting machine**

8.1 A vote recorded in the primary ballot module must be the vote that the voter has cast. The voting machine must be capable of recording votes on 5 ballot papers (maximum 90 preferences) simultaneously as per paragraph 13. The capacity of the ballot module is set out in paragraph 1.8 of the Functional Specification.

8.2 Subject to 10.3, a cast vote must not be lost by a power failure, the failing of one component, the effect of environmental conditions detailed in paragraph 11.1, through normal use or through failures in the operation of the voting machine.

8.3 The installed ballot module and its contents must be fully maintained in case of a power failure, the effect of environmental conditions as set out in paragraph 11.1, through normal use or through failures in the operation of the voting machine.

8.4 The functions of the voting machine must be fully maintained in the event of a power failure, or exposure to the environmental conditions as detailed in 11.1.

8.5 The storing of votes in the ballot module must be made in such a way so as to ensure security and continuous self-checking of all data. Each vote will be stored twice in each of 2 independent IC’s within the ballot module i.e. each

vote is stored four times in the ballot module. As each single preference is recorded, a checksum (a security code applied over a number of bytes based upon Hamming Code which is an international standard) is calculated and stored in the RAM. When the voter presses the “CAST VOTE(S)” button, all checksums of all preferences stored in RAM shall be checked. As the voting machine stores preferences, a read back of the last byte of data written should be made as a further check. After storing all preferences, the system should check all of these again and their checksums. The last step is a check of all preferences stored from all voters. This sequence is repeated for every voting cycle.

In the event that a discrepancy occurs in the checksums, an error message is generated. This message is shown on the voting machine display and on the Control Unit display enabling the presiding officer to take appropriate action.

8.6 The voting machine should, as far as is reasonably and technically possible, avoid or restrict the possibilities of accidental or intentional incorrect use.

8.7 The voting machine shall have a physical seal on the cover of the electronics unit to prevent the exchange or interference with program chips.

8.8 The votes shall be stored randomly in the ballot module and must not be displayed or printed on the voting machine.

9. **Operability**

9.1 The voting machine shall be configured so that a voter can only carry out voting actions on it.

9.2 Voting on the voting machine must be easy to understand.

9.3 The carrying out of an action by the presiding officer or by the voter must lead to a visible, audible or tangible feedback signal within one second.

9.4 When the voter records a preference or casts a vote by means of the buttons on the voting machine, the following requirements shall apply to the buttons:

- minimum dimensions: square 10 x 10 (mm), round 10 (mm);
- maximum operating force for the selection of a candidate: 4(N);
- maximum travel when buttons are pushed for selection of a preference for a candidate: 6(mm);
- minimum travel when buttons are pushed: 0(mm).

10. **Reporting and solution of problems**

10.1 The voting machine shall, as far as possible, be equipped with a diagnostic mechanism, so that after each action that has been performed within the voting machine, the mechanism can detect defects or incorrect working of the different components of the voting machine and their associated communication channels. These actions must include the steps that the voter or the polling staff can perform. The voting machine must report a defect or incorrect working to the user.

10.2 In the event of a power failure between 500 msec and 2000 msec of pressing the CAST VOTE(S) button, a vote stored in the Eeprom of the machine shall not be lost, providing there is no fatal machine failure on restoration of power.

10.3 In the event of a voting machine failure that affects the vote storage process (between 500 msec and 2000 msec of pressing the “CAST VOTE(S)” button), unless the failure is such as to cause a complete shut down of the machine, an error message shall be displayed e.g. error no. xxxx – vote not stored.

10.4 The diagnostic mechanism shall not be accessible to or be capable of being switched off by the user.

10.5 The diagnostic mechanism must provide the user with messages (text or code) that support and speed up the trouble shooting procedure.

10.6 The meaning of the fault messages generated by the diagnostic mechanism and the actions to be taken with respect to each fault message must be clearly stated in the voting machine user manual for help desk staff.

11. **Environmental conditions (derived from [OIML-11], [IEC-60839], [IEC-60068-2] or as amended, adapted or extended by or under any subsequent version of these documents or replacement documents**

11.1 Environmental conditions referred to in 8.2, 8.3 and 8.4 are:

- Environmental temperature: [IEC-60839-1-3], [IEC-60068-2], 5˚C to 40˚C.
- Relative humidity: [IEC-60068-2] 85% at 40˚C (upper limit) “non condensing”.
- Power supply voltage: [IEC-60839-1-3] 230V + 10%, -10%; 50Hz ± 2%.
- Power supply cuts (current interruption): the voting machine must be equipped with a connection to an emergency power (emergency power generator or batteries).
- Power cuts with short time durations: [IEC-60839] 500 ms (black outs) and suppression up to 75% of the nominal voltage (brown out) must not lead to loss of function and information.
- Electromagnetic compatibility (EMC); this equipment must comply with EN 50081-1 and EN 50082-1, for which the following tests apply:
  - Fast transients: [EN 50082-1]; 1 kV on the power supply surge test: [EN 50082-1]; 1kV in differential mode, 2 kV in common mode.
  - Air discharge: [EN 50082-1]; ESD test with 16 kV discharges.
  - Electromagnetic disturbances: [EN 50082-1]; Radiated: 80 – 100 MHz, field strength 3 V/m, modulated. Conducted, via power supply: 0. 150 MHz – 80 MHz, 3 V.
  - Insulation: [IEC-60839]; > 10Mohm under all temperature and humidity conditions the insulation of the power supply circuit must be resistant to a voltage of 2 kV between the phase and the 0 wire connected together and to earth during 10 seconds.
  - Housing: [IEC-60529].

- Drip water proof, IP x 1 (valid for all components of the machine that are in direct contact with the voter).
- Energy consumption: an energy consumption such that the emergency power supply (for instance a battery) can maintain the voting machine fully operational for at least 8 hours without replacement.

11.2 The functions of the voting machine will be maintained after being exposed to the following conditions during storage:

- Environmental temperature: [IEC-60068-2] -25˚C - +70˚C.
- Relative humidity: [IEC-60068-2]; 95% at 40˚C (upper limit) “non condensing”.
- Temperature change: [IEC-60068-2]; 25˚C to 30˚C.
- Mechanical vibration: [IEC-60068-2].
- Random: acceleration spectral density 1 m/s^3 (100 – 200 Hz), 0.3 m/s^3 (200 – 2000 Hz) during 1 hour per direction.
- Sinus form: 10 m/s (10 – 200 Hz) 15 m/s (200 – 500 Hz).
- Free drop: [IEC-60068-2]; flat, 2 x per side from a height of 0.25m.
- Tilt: [IEC-60068-2]; along each edge of the packaging.

References:

[EN-50081-1] Electromagnetic compatibility, general emission standard, part 1.

[EN 50082-1] Electromagnetic compatibility, general immunity standard, part 1.

[IEC-60255] Single input energising quantity measuring relays with dependent specified time. Appendix E: Impulse voltage resistance tests and high frequency disturbance tests.

[IEC-60721] Classification of environmental conditions.

Part 3 Classification of groups of environmental parameters and their severity’s – Transportation.

IEC Publication 60721-3-2.

[EN-61000] Electromagnetic compatibility for industrial process measurement and control equipment.

Part 1 General. Section 1; application and interpretation of fundamental definitions and terms;

Part 4 Testing and measurement techniques – Section 2; Electrostatic discharge immunity test.

Section 3: Radiated, radio frequency, electromagnetic field immunity test.

Section 4: Electrical fast transient/burst immunity test.

IEC Publication 60801.

[IEC-60839] Alarm systems Part 1 General requirements.

Section 3 Environmental testing.

IEC Publication 60839-1-3.

[OIML-11] General requirements for electronic measuring instruments.

OIML International document 11draft revision; version NWG 1.1; March 2002.

12. **Manual handling of voting machine**

The manufacturer shall ensure, as far as is reasonably practicable, that the voting machine case is designed and constructed so as to be safe and without risk to the safety and health when moved, opened or closed by persons employed at a poll. The design and build shall be such as to enable the returning officer (the employer) to comply with Council Directive 90/269/EEC of 29 May 1990 and the Safety, Health and Welfare at Work Act, 1989 (sections 6, 7, 8, 9, 10 and 11) – copies at Part 2 of this Appendix.

Regard shall also be had to the following publications of the European Agency for Safety and Health at Work:

- Factsheet (No. 10) on work-related low back disorders; and

- Research on work related low back disorders report (October, 2000) (http://agency.osha.eu.int/publications/reports/lowback/) – in particular the 1S0 ergonomic standards listed in Chapter 4.4 (see item 3 in Part 2 of the Appendix).

13. **Conditions for the use of voting machines for two or more polls simultaneously**

The voting machines may be used for one, two or more (maximum 5) polls that are held simultaneously, including an election and a referendum. The voting machine shall be equipped in such a way that it fulfils the following requirements:

- the designation of the selection buttons for each ballot paper is stored in tabular form in the ballot module;
- the voting machine can be activated for the voter for a maximum of 5 polls;
- the ballot papers displayed on the voting machine are clearly separated from each other;
- the voter can record preferences starting on any ballot paper. The preferences will start from 1 on each ballot paper (except a referendum ballot paper). The voter may switch between ballot papers until he/she has finished recording his/her preferences;
- the cast votes are stored randomly and cannot be displayed or printed on the voting machine.

14. **Documentation**

14.1 The voting machine must be supplied with the following documentation:

- system documentation;
- development documentation;
- test documentation;
- a user manual;
- instructions for the voter.

14.2 The system documentation shall describe:

(a) the working principle of the voting machine and the additional equipment and a description of the construction (both electronic and mechanical) explained with:

- construction drawings,
- block diagrams, electronic and wiring diagrams, printed circuit board layouts.

(b) specifications of the environmental and operating conditions for normal operation, storage and transport of the voting machine;

(c) identification data, including:

- serial, type and ordering numbers,
- production and/or delivery date,
- electrical connection/power supply.

This identification data must also be adequately indicated on the voting machine and the additional equipment.

14.3 The development documentation must include:

(a) a functional specification of the voting machine and programming unit;
(b) the technical design of the voting machine and programming unit;
(c) listings of the application source codes;
(d) a quality plan.

14.4 The test documentation must describe which measurements the manufacturer used at the verification, the validation and the testing of components of the voting machine (including software) and must include at least:

- a test plan that describes the way in which the functions of the machine and programming unit are tested;

- software module test report that describes the results of the module tests;

- software integration test report(s) that describe the results of the integration tests;

- software system test plan and report(s) containing the system test plan (test specification) and results.

14.5 **The user manual**

The user manual must include:

- manual handling requirements (Council Directive 90/269/EEC of 29 May 1990);

- instructions for unpacking, opening, connecting and putting the voting machine into operation;

- operating instructions for the adjustment of the voting machine and security and/or locking;

- operating instructions for the members of the polling station;

- maintenance instructions;

- storage instructions.

14.6 **Instructions for the voter**

This document shall contain the instructions for a voter to use the voting machine.

PART 2

1. Council Directive 90/269/EEC of 29 May 1990.

2. Safety, Health and Welfare at Work Act, 1989 (sections 2, 6 to 11).

3. Report on work related low back disorders report for European Agency for Safety and Health at Work – Chapter 4.4 on guidelines and standards related to prevention of low back disorders.

Council Directive 90/269/EEC of 29 May 1990 on the minimum health and safety requirements for the manual handling of loads where there is a risk particularly of back injury to workers (fourth individual Directive within the meaning of Article 16 (1) of Directive 89/391/EEC)

Official Journal L 156 , 21/06/1990 p. 0009 - 0013
Finnish special edition....: Chapter 5 Volume 4 p. 198
Swedish special edition...: Chapter 5 Volume 4 p. 198
Amendments:
Incorporated by 294A0103(68) (OJ L 001 03.01.1994 p.484)

Text:
THE COUNCIL OF THE EUROPEAN COMMUNITIES,

Having regard to the Treaty establishing the European Economic Community, and in particular Article 118a thereof

Having regard to the Commission proposal (1) submitted after consultation with the Advisory Committee on Safety, Hygiene and Health Protection at Work,

In cooperation with the European Parliament (2),

Having regard to the opinion of the Economic and Social Committee(3),

Whereas Article 118a of the Treaty provides that the Council shall adopt, by means of Directives, minimum requirements for encouraging improvements, especially in the working environment, to guarantee a better level of protection of the health and safety of workers;

Whereas, pursuant to that Article, such Directives must avoid imposing administrative, financial and legal constraints in a way which would hold back the creation and development of small and medium-sized undertakings;

Whereas the Commission communication on its programme concerning safety, hygiene and health at work (4), provides for the adoption of Directives designed to guarantee the health and safety of workers at the workplace;

Whereas the Council, in its resolution of 21 December 1987 on safety, hygiene and health at work (5), took note of the Commission's intention of submitting to the Council in the near future a Directive on protection against the risks resulting from the manual handling of heavy loads;

Whereas compliance with the minimum requirements designed to guarantee a better standard of health and safety at the workplace is essential to ensure the health and safety of workers;

Whereas this Directive is an individual Directive within the meaning of Article 16 (1) of Council Directive 89/391/EEC of 12 June 1989 on the introduction of measures to encourage improvements in the health and safety of workers at work (6); whereas therefore the provisions of the said Directive are fully applicable to the field of the manual handling of loads where there is a risk particularly of back injury to workers, without prejudice to more stringent and/or specific provisions set out in this Directive;

Whereas this Directive constitutes a practical step towards the achievement of the social dimension of the internal market;

Whereas, pursuant to Decision 74/325/EEC (7), the Advisory Committee on Safety, Hygiene and Health Protection at Work shall be consulted by the Commission with a view to drawing up proposals in this field, HAS ADOPTED THIS DIRECTIVE:

SECTION I
GENERAL PROVISIONS

Article 1
Subject

1. This Directive, which is the fourth individual Directive within the meaning of Article 16 (1) of Directive 89/391/EEC, lays down minimum health and safety requirements for the manual handling of loads where there is a risk particularly of back injury to workers.

2. The provisions of Directive 89/391/EEC shall be fully applicable to the whole sphere referred to in paragraph 1, without prejudice to more restrictive and/or specific provisions contained in this Directive.

Article 2
Definition

For the purposes of this Directives, 'manual handling of loads' means any transporting or supporting of a load, by one or more workers, including lifting, putting down, pushing, pulling, carrying or moving of a load, which, by reason of its characteristics or of unfavourable ergonomic conditions, involves a risk particularly of back injury to workers.

SECTION II
EMPLOYERS' OBLIGATIONS

Article 3
General provision

1. The employer shall take appropriate organizational measures, or shall use the appropriate means, in particular mechanical equipment, in order to avoid the need for the manual handling of loads by workers.

2. Where the need for the manual handling of loads by workers cannot be avoided, the employer shall take the appropriate organizational measures, use the appropriate means or provide workers with such means in order to reduce the risk involved in the manual handling of such loads, having regard to Annex I.

Article 4
Organization of workstations

Wherever the need for manual handling of loads by workers cannot be avoided, the employer shall organize workstations in such a way as to make such handling as safe and healthy as possible and:

(a) assess, in advance if possible, the health and safety conditions of the type of work involved, and in particular examine the characteristics of loads, taking account of Annex I;

(b) take care to avoid or reduce the risk particularly of back injury to workers, by taking appropriate measures, considering in particular the characteristics of the working environment and the requirements of the activity, taking account of Annex I.

Article 5
Reference to Annex II

For the implementation of Article 6 (3) (b) and Articles 14 and 15 of Directive 89/391/EEC, account should be taken of Annex II.

Article 6
Information for, and training of, workers

1. Without prejudice to Article 10 of Directive 89/391/EEC, workers and/or their representatives shall be informed of all measures to be implemented, pursuant to this Directive, with regard to the protection of safety and of health. Employers must ensure that workers and/or their representatives receive general indications and, where possible, precise information on:

- the weight of a load,
- the centre of gravity of the heaviest side when a package is eccentrically loaded.

2. Without prejudice to Article 12 of Directive 83/391/EEC, employers must ensure that workers receive in addition proper training and information on how to handle loads correctly and the risks they

might be open to particularly if these tasks are not performed correctly, having regard to Annexes I and II.

Article 7
Consultation of workers and workers' participation
Consultation and participation of workers and/or of their representatives shall take place in accordance with Article 11 of Directive 89/391/EEC on matters covered by this Directive, including the Annexes thereto.

SECTION III
MISCELLANEOUS PROVISIONS

Article 8
Adjustment of the Annexes
Alterations of a strictly technical nature to Annexes I and II resulting from technical progress and changes in international regulations and specifications or knowledge in the field of the manual handling of loads shall be adopted in accordance with the procedure provided for in Article 17 of Directive 89/391/EEC.

Article 9
Final provisions
1. Member States shall bring into force the laws, regulations and administrative provisions needed to comply with this Directive not later than 31 December 1992.

They shall forthwith inform the Commission thereof.

2. Member States shall communicate to the Commission the text of the provisions of national law which they adopt, or have adopted, in the field covered by this Directive.

3. Member States shall report to the Commission every four years on the practical implementation of the provisions of this Directive, indicating the points of view of employers and workers.

The Commission shall inform the European Parliament, the Council, the Economic and Social Committee and the Advisory Committee on Safety, Hygiene and Health Protection at Work thereof.

4. The Commission shall report periodically to the European Parliament, the Council and the Economic and Social Committee on the implementation of the Directive in the light of paragraphs 1, 2 and 3.

Article 10
This Directive is addressed to the Member States.
Done at Brussels, 29 May 1990.
For the Council
The President
B. AHERN

(1) OJ No C 117, 4. 5. 1988, p. 8.
(2) OJ No C 326, 19. 12. 1988, p. 137 and OJ No C 96, 17. 4. 1990, p. 82.
(3) OJ No C 318, 12. 12. 1988, p. 37.
(4) OJ No C 28, 3. 2. 1988, p. 3.
(5) OJ No C 28, 3. 2. 1988, p. 1.
(6) OJ No L 183, 29. 6. 1983, p. 1.
(7) OJ No L 185, 9. 7. 1974, p. 15.

ANNEX I
(*) REFERENCE FACTORS (Article 3 (2), Article 4 (a) and (b) and Article 6 (2))

1. Characteristics of the load

The manual handling of a load may present a risk particularly of back injury if it is:

- too heavy or too large,

- unwieldy or difficult to grasp,
- unstable or has contents likely to shift,
- positioned in a manner requiring it to be held or manipulated at a distance from the trunk, or with a bending or twisting of the trunk,
- likely, because of its contours and/or consistency, to result in injury to workers, particularly in the event of a collision.
-

2. Physical effort required
A physical effort may present a risk particularly of back injury if it is:

- too strenuous,
- only achieved by a twisting movement of the trunk,
- likely to result in a sudden movement of the load,
- made with the body in an unstable posture.

3.Characteristics of the working environment
The characteristics of the work environment may increase a risk particularly of back injury if:

- there is not enough room, in particular vertically, to carry out the activity,
- the floor is uneven, thus presenting tripping hazards, or is slippery in relation to the worker's footwear,
- the place of work or the working environment prevents the handling of loads at a safe height or with good posture by the worker,
- there are variations in the level of the floor or the working surface, requiring the load to be manipulated on different levels,
- the floor or foot rest is unstable,
- the temperature, humidity or ventilation is unsuitable.

4. Requirements of the activity
The activity may present a risk particularly of back injury if it entails one or more of the following requirements:

- over-frequent or over-prolonged physical effort involving in particular the spine,
- an insufficient bodily rest or recovery period,
- excessive lifting, lowering or carrying distances,
- a rate of work imposed by a process which cannot be altered by the worker.

(*) With a view to making a multi-factor analysis, reference may be made simultaneously to the various factors listed in Annexes I and II.

ANNEX II
(*) INDIVIDUAL RISK FACTORS (Articles 5 and 6 (2))

The worker may be at risk if he/she:

- is physically unsuited to carry out the task in question,
- is wearing unsuitable clothing, footwear or other personal effects,
- does not have adequate or appropriate knowledge or training.

(*) With a view to multi-factor analysis, reference may be made simultaneously to the various factors listed in Annexes I and II.

Source: European Commission Employment and Social Affairs
Current status 15 October 1999.
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***Number* 7 *of* 1989**

SAFETY, HEALTH AND WELFARE AT WORK ACT, 1989

AN ACT TO MAKE FURTHER PROVISION FOR SECURING THE SAFETY, HEALTH AND WELFARE OF PERSONS AT WORK, FOR PROTECTING OTHERS AGAINST RISKS TO SAFETY OR HEALTH IN CONNECTION WITH THE ACTIVITIES OF PERSONS AT WORK, FOR THE ESTABLISHMENT OF A NATIONAL AUTHORITY FOR OCCUPATIONAL SAFETY AND HEALTH, TO PROVIDE FOR THE REPEAL OF CERTAIN ENACTMENTS, TO PROVIDE FOR THE FURTHER REGULATION OF DANGEROUS SUBSTANCES IN SO FAR AS THEY MAY AFFECT PERSONS OR PROPERTY AND FOR MATTERS CONNECTED WITH THE AFORESAID.

[19th April, 1989]

Interpretation.

2. — (1) In this Act—

"article" includes—

(a) any plant, machinery, apparatus and equipment for use or operation (whether exclusively or not) by persons at work, and

(b) any article designed for use as a component in any such plant, machinery, apparatus or equipment;

"associated statutory provisions" means the provisions of the enactments specified in the *third column* of the *Third Schedule* together with the instruments made under them for the time being in force;

"the Authority" means the National Authority for Occupational Safety and Health established by *section 15*;

"code of practice" includes a standard, a specification, and any other written or illustrated form of practical guidance, instruction or control, issued or approved of in accordance with *section 30*;

"contract of employment" means a contract of employment or service or of apprenticeship, whether it is expressed or implied and (if it is express) whether it is oral or in writing;

"employee" means a person who has entered into or works (or in the case of a contract which has been terminated, worked) under a contract of employment with an employer;

"employer" in relation to an employee, means the person by whom the employee is employed under a contract of employment; for the purpose of this definition a person holding office under or in the service of the State or of the Government shall be deemed to be employed by the State or the Government (as the case may be) and an officer or servant of a local authority or of a harbour authority, health board or vocational education committee shall be deemed to be employed by the local authority, harbour authority, health board or vocational education committee (as the case may be);

"enforcing agency" means a body prescribed to be an enforcing agency under *section 32*;

"establishment day" means the day appointed by the Minister under *section 14* to be the establishment day;

"existing enactments" means the enactments specified in *Part I* of the *Second Schedule*, and any instruments under them, for the time being in force; and the regulations under the European Communities Act, 1972, for the time being in force specified in *Part II* of the said

Second Schedule;

"functions" includes powers and duties;

"improvement notice" means a notice under *section 36*;

"improvement plan" means a plan under *section 35*;

"inspector" means an inspector authorised under *section 33*;

"local authority" includes—

(a) the council of a county,

(b) the corporation of a county borough, or

(c) the Corporation of Dún Laoghaire,

and such local authority shall exercise its functions under this Act within its functional area;

"micro-organism" includes any microscopic biological entity which is capable of replication;

"the Minister" means the Minister for Labour;

"occupational medical adviser" means a person designated under *section 34 (4)* to be an occupational medical adviser;

"personal injury" includes any disease and any impairment of a person's physical or mental condition;

"place of work" includes any place, land or other location at, in, upon or near which, work is carried on whether occasionally or otherwise and in particular includes—

(a) a premises,

(b) an installation on land and any offshore installation (including any offshore installation to which the Safety, Health and Welfare (Offshore Installations) Act, 1987, applies),

(c) a tent, temporary structure or movable structure, and

(d) a vehicle, vessel or aircraft;

"prescribed" means prescribed by regulations made under this Act by the Minister except in *sections 36 (3), 37 (6) (a)* and *42 (4) (a)* where it means prescribed by regulations made under this Act by the Minister for Justice in consultation with the Minister;

"prohibition notice" means a notice under *section 37*;

"recognised trade unions and staff associations" means trade unions and staff associations recognised by the Authority for the purposes of negotiations which are concerned with the remuneration, conditions of employment or working conditions of employees;

"relevant statutory provisions" means existing enactments and the provisions of this Act and any instrument made under it for the time being in force;

"safety representative" means a safety representative appointed under *section 13*;

"safety statement" has the meaning assigned to it by *section 12*;

"self-employed person" means a person who works for profit or gain otherwise than under a contract of employment, whether or not he himself employs other persons;

"substance" includes any natural or artificial substance, preparation or agent in solid or liquid form or as a gas or vapour or as a micro organism;

"use" in so far as any article is concerned includes the manufacture, supply, operation, setting, repair, cleaning and maintenance of such articles; and in so far as any substance is concerned, includes any manufacture, process, operation, storage, treatment, mixing, packing, conveyance, supply, handling, filling or emptying, loading and unloading of such substance.

(2) (a) In this Act a reference to a section or a Schedule is to a section of, or a Schedule to, this Act unless it is indicated that reference to some other enactment is intended;

(b) in this Act a reference to a subsection, paragraph or subparagraph is a reference to the subsection, paragraph or subparagraph of the provision in which the reference occurs unless it is indicated that reference to some other provision is intended; and

(c) a reference in this Act to any enactment shall be construed as a reference to that enactment as amended or adapted by any subsequent enactment.

(3) References to an inspector in *sections 35, 36* and *37* shall, in any case in which the enforcing agency is a local authority, be construed as a reference to that local authority.

General duties of employers to their employees.

6. — (1) It shall be the duty of every employer to ensure, so far as is reasonably practicable, the safety, health and welfare at work of all his employees.

(2) Without prejudice to the generality of an employer's duty under *subsection (1)*, the matters to which that duty extends include in particular—

(a) as regards any place of work under the employer's control, the design, the provision and the maintenance of it in a condition that is, so far as is reasonably practicable, safe and without risk to health;

(b) so far as is reasonably practicable, as regards any place of work under the employer's control, the design, the provision and the maintenance of safe means of access to and egress from it;

(c) the design, the provision and the maintenance of plant and machinery that are, so far as is reasonably practicable, safe and without risk to health;

(d) the provision of systems of work that are planned, organised, performed and maintained so as to be, so far as is reasonably practicable, safe and without risk to health;

(e) the provision of such information, instruction, training and supervision as is necessary to ensure, so far as is reasonably practicable, the safety and health at work of his employees;

(f) in circumstances in which it is not reasonably practicable for an employer to control or eliminate hazards in a place of work under his control, or in such circumstances as may be prescribed, the provision and maintenance of such suitable

protective clothing or equipment, as appropriate, that are necessary to ensure the safety and health at work of his employees;

(g) the preparation and revision as necessary of adequate plans to be followed in emergencies;

(h) to ensure, so far as is reasonably practicable, safety and the prevention of risk to health at work in connection with the use of any article or substance;

(i) the provision and the maintenance of facilities and arrangements for the welfare of his employees at work; and

(j) the obtaining, where necessary, of the services of a competent person (whether under a contract of employment or otherwise) for the purpose of ensuring, so far as is reasonably practicable, the safety and health at work of his employees.

(3) For the purposes of this section, a person who is undergoing training for employment or receiving work experience, other than when pursuing a course of study in a university, school or college, shall be deemed to be an employee of the person whose undertaking (whether carried on by him for profit or not) is for the time being the immediate provider to that person of training or work experience, and employee, employer and cognate words and expressions shall be construed accordingly.

General duties of employers and self-employed to persons other than their employees.

7. — (1) It shall be the duty of every employer to conduct his undertaking in such a way as to ensure, so far as is reasonably practicable, that persons not in his employment who may be affected thereby are not exposed to risks to their safety or health.

(2) It shall be the duty of every self-employed person to conduct his undertaking in such a way as to ensure, so far as is reasonably practicable, that he and other persons (not being his employees) who may be affected thereby are not exposed to risks to their safety or health.

(3) In such cases as may be prescribed, it shall be the duty of every employer and self-employed person, in the prescribed circumstances, and in the prescribed manner to give to persons (not being his employees) who may be affected by the way in which he conducts his undertaking the prescribed information about such aspects of the way he conducts his undertaking as might affect their safety or health.

General duties of persons concerned with places of work to persons other than their employees.

8. — (1) This section has effect for imposing on persons duties in relation to those who are not their employees but who are either the employees of another person or are self-employed and who for the purposes of carrying out work use a non-domestic place of work made available to them or in which they may for the purposes of carrying out work use any article or substance provided for their use there, and it applies to places of work so made available and other non domestic places of work used in connection with them.

(2) It shall be the duty of each person who has control, to any extent, of any place of work or any part of any place of work to which this section applies or of the means of access thereto or egress therefrom or of any article or substance in such place of work to take such measures as is reasonable for a person in his position to take to ensure, so far as is reasonably practicable, that the place of work, all means of access thereto, or egress therefrom available for use by persons using the place of work, and any article or substance in the place of work or, as the case may be, provided for use therein, is or are safe and without risks to health.

(3) Where a person has, by virtue of any contract or tenancy, an obligation of any extent as to—

(a) the maintenance or repair of any place of work to which this section applies or any means of access thereto or egress therefrom; or

(b) the safety of or the absence of risk to health arising from any article or substance in any such place of work;

that person shall be treated, for the purposes of *subsection (2)*, as being a person who has control of the matters to which his obligation extends.

(4) Any reference in this section to a person having control of any place of work or matter is a reference to a person having control of the place of work or matter in connection with the carrying on by him of a trade, business or other undertaking (whether for profit or not).

General duties of employees.

9. — (1) It shall be the duty of every employee while at work—

(a) to take reasonable care for his own safety, health and welfare and that of any other person who may be affected by his acts or omissions while at work;

(b) to co-operate with his employer and any other person to such extent as will enable his employer or the other person to comply with any of the relevant statutory provisions;

(c) to use in such manner so as to provide the protection intended, any suitable appliance, protective clothing, convenience, equipment or other means or thing provided (whether for his use alone or for use by him in common with others) for securing his safety, health or welfare while at work; and

(d) to report to his employer or his immediate supervisor, without unreasonable delay, any defects in plant, equipment, place of work or system of work, which might endanger safety, health or welfare, of which he becomes aware.

(2) No person shall intentionally or recklessly interfere with or misuse any appliance, protective clothing, convenience, equipment or other means or thing provided in pursuance of any of the relevant statutory provisions or otherwise, for securing the safety, health or welfare of persons arising out of work activities.

General duties of designers, manufacturers, etc., as regards articles and substances for use at work.

10. — (1) It shall be the duty of any person who designs, manufactures, imports or supplies any article for use at work—

(a) to ensure, so far as is reasonably practicable, that the article is designed, constructed, tested and examined so as to be safe and without risk to health when used by a person at a place of work;

(b) to take such steps as are necessary to secure that persons supplied by that person with the article are provided with adequate information about the use for which it is designed or has been tested, and about any conditions relating to the article so as to ensure that, when in use, dismantled or disposed of, it will be safe and without risk to health; and

(c) to take such steps as are necessary to secure, so far as is reasonably practicable, that persons so supplied are provided with all such revisions of information provided to them by virtue of *paragraph (b)* as are necessary by reason of its becoming known that anything relating to the article

gives rise to a serious risk to safety or health.

(2) It shall be the duty of any person who undertakes the design or manufacture of any article for use at work to carry out or arrange for the carrying out of any necessary research with a view to the discovery and, so far as is reasonably practicable, the elimination or minimisation of any risks to safety or health to which the design or article may give rise.

(3) It shall be the duty of any person who erects or installs any article for use at a place of work where that article is to be used by persons at work to ensure, so far as is reasonably practicable, that nothing about the way in which the article is erected or installed makes it unsafe, or a risk to health when in use at a place of work.

(4) It shall be the duty of any person who manufactures or imports or supplies any substance—

(a) to ensure, so far as is reasonably practicable, that the substance will be safe and without risks to health when it is being used by a person at a place of work;

(b) to carry out or arrange for the carrying out of such testing and examination as may be necessary for the performance of the duty imposed on him by *paragraph (a)* and whenever requested by an inspector provide or cause to be provided to him evidence, including documentary evidence of such testing and examination;

(c) to take such steps as are necessary to ensure that persons supplied by that person with the substance are provided with adequate information about any risk to safety or health to which the inherent properties of the substance may give rise, about the results of any relevant tests which have been carried out on or in connection with the substance and about any conditions necessary to ensure that the substance will be safe and without risk to health when the substance is being used or being disposed of.

(5) It shall be the duty of any person who undertakes the manufacture of any substance, or in a case where the manufacture was undertaken outside the State it shall be the duty of the importer, to carry out or arrange for the carrying out of any necessary research with a view to the discovery and, so far as is reasonably practicable, the elimination or minimisation of any risks to safety or health to which the substance may give rise when in use.

(6) Nothing in the preceding provisions of this section shall be construed as requiring a person to repeat any testing, examination or research which has been carried out otherwise than by him or at his instance, in so far as it is reasonable for him to rely on the results thereof, for the purposes of those provisions.

(7) Any duty imposed on a person by any of the preceding provisions of this section shall extend only to things done in the course of a trade, business or other undertaking carried on by him (whether for profit or not) and to matters within his control.

(8) Where a person designs, manufactures, imports or supplies an article for use at work and does so for or to another person on the basis of a written undertaking by that other person to take specified steps that are sufficient to ensure, so far as is reasonably practicable, that the article shall be safe and without risks to health when it is being used at a place of work, the said undertaking shall have the effect of relieving the first mentioned person from the duty imposed by virtue of *paragraph (a)* of *subsection (1)* to such extent as is reasonable having regard to the terms of the said undertaking.

(9) Nothing in *subsections (7)* or *(8)* shall relieve any person who imports any article or substance from any duty in respect of anything which—

(a) in the case of an article designed outside the State, was done by and in the course of any trade, profession or other undertaking carried on by, or was within the control of, the person who designed the article; or

(b) in the case of an article or substance manufactured outside the State, was done by and in the course of any trade, profession or other undertaking carried on by, or was within the control of, the person who manufactured the article or substance.

(10) Where a person (hereinafter referred to in this subsection as "the supplier") supplies, including hires or leases, to another person (hereinafter referred to in this subsection as "the customer") any article or substance for use at work, under a hire-purchase agreement, a leasing agreement or credit-sale agreement, and the supplier—

(a) carried on the business of financing the acquisition of goods by others by means of such agreements, and

(b) in the course of that business acquired his interest in the article or substance supplied to the customer as a means of financing its acquisition by the customer from a third party (hereinafter referred to in this subsection as "the dealer"),

the dealer and not the supplier, shall be treated for the purposes of this section as supplying the article or substance to the customer, and any duty imposed by this section on suppliers shall, accordingly, fall on the dealer and not on the supplier.

(11) For the purposes of this section an absence of safety or risk to health shall be disregarded in so far as the case is or in relation to which it would arise is shown to be one the occurrence of which could not reasonably be foreseen; and in determining whether any duty imposed by virtue of *paragraph (a)* of *subsections (1)* or *(4)* has been performed regard shall be had to any relevant information or advice which has been provided to any person by the person by whom the article has been designed, manufactured, imported or supplied or, as the case may be, by the person by whom the substance has been manufactured, imported or supplied.

(12) Without prejudice to the generality of this section, the Minister may prescribe specifications or other requirements with which the design, manufacture and construction of any article, which is of a prescribed class or description, shall comply.

(13) Where an article or substance is used at work, and a request is made in that behalf by an inspector, the employer shall give to the inspector the name and address of the person from whom the article or substance was purchased or otherwise obtained.

General duties of persons who design or construct places of work.

11. — (1) It shall be the duty of any person who designs places of work to design them so that they are, so far as is reasonably practicable, safe and without risk to health.

(2) It shall be the duty of any person who constructs places of work to construct them so that they are, so far as is reasonably practicable, safe and without risk to health.

4.4 GUIDELINES AND STANDARDS RELATED TO PREVENTION OF LOW BACK DISORDERS

Regulatory actions are based on two distinct elements - risk assessment and risk management. In the former, facts are used to define the health effects of the exposure of individuals or populations to hazardous situations. The latter is a process of integrating the results of risk assessment with engineering data and with social, economic, and political concerns to select the most appropriate regulatory action. For these two elements, a scientific basis of risk assessment is necessary, and therefore both epidemiological studies on human populations and experimental studies have considerable importance (National Research Council in Viikari-Juntura, 1997).

The Manual Handling Directive (Council Directive 90/269/EEC) is made with the primary goal of preventing back injury during the manual handling of loads. Minimum health and safety requirements are given for the manual
handling of loads and a series of relevant factors are listed in annexes to the directive (See Appendix 2). Employers should to pay attention to these risk factors when making assessments and selecting preventive measures. They
include:

• Characteristics of the load (for example: it is heavy or difficult to hold);

• Physical effort required (for example: strenuous; twisting; body in an unstable position);

• Characteristics of the working environment (for example: insufficient room or other constraints on the posture of worker such as working height too high or low; uneven or slippery flooring);

• Requirements of the activity (for example: prolonged activity or effort; insufficient rest periods; excessive distances to move loads; imposed work rate)

• Individual factors (for example: clothing etc.restricting movement; nadequate
knowledge or training)

ISO ergonomic standards are developed with the aim of standardising for example terminology, methodology, and human factors data in the field of ergonomics. In the ISO / TC159 / SC3 group the following items are addressed: anthropometry, evaluation of working postures and human physical strength. The draft standards that are being prepared will be of importance with regard to the physical aspects during work and the occurrence of low back disorders. Until now, the following standards have been developed:

• ISO 7250:1996: basic human body measurements for technological design

• ISO 15534-1:2000: Ergonomic design for the safety of machinery – Part 1: principles for determining the dimensions required for openings for whole-body access to machinery

• ISO 15534-2:2000: Ergonomic design for the safety of machinery – Part 2: principles for determining the dimensions required for access openings

• ISO 15534-3:2000: Ergonomic design for the safety of machinery – Part 3: anthropometric data.

Other guidelines relevant to the prevention of low back disorders include ISO 2631-1 and ISO 5349.

Also working group 4: Biomechanics of the Technical Committee CEN/TC 122 – “Ergonomics” is further developing a European standard prEN 1005 2: “Safety of machinery-Human physical performance-part 2: Manual handling of machinery and component parts of machinery”. This European standard has been prepared under a mandate from the European Commission and the European Free Trade Association and supports essential requirements
of the Machinery Directive 98/37/EC.

To evaluate lumbar load with respect to the risk of overexertion during manual material handling, the National Institute of Occupational Safety and Health introduced the ‘NIOSH’ method. A lifting formula

(equation), a multiplication model with six task variables, has been proposed to protect healthy workers (see also 5.5).

To obtain more information on the risks of vibration and to calculate an occupational vibration-exposure dose, recommendations and references are given by Johanning (2000).

4.5
CONCLUSIONSON EFFECTIVENESS OF PREVENTION

The demand for workplace interventions to prevent low back disorders has increased in recent years. Strategies to prevent low back disorders include both workplace based and health care based interventions. Increasingly
there is recognition that an integrated approach including both types of intervention is needed to really tackle the problem effectively. Ergonomics interventions are based on a “holistic” or systems approach that considers
the effect of the equipment, the work environment and the work organisation as well as the worker. The full participation of workers in the ergonomics approach is important for its effectiveness.

There are dissenting views in the literature on whether or not the programmes work. The discrepancies are often attributed to the different methodological quality of the studies: lack of control groups, lack of randomisation, lack of a placebo group, small number of subjects, no standardisation of the environment, (Nordin, 1997; Volinn, 1999). Other negative factors are high costs of interventions, lack of underlying commitment